6/29/00 Suttie Dep.

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

HONEYWELL INTERNATIONAL INC., and HONEYWELL INTELLECTUAL PROPERTY, INC.,

Plaintiffs,

vs. No. 99-309 (GMS)

HAMILTON SUNDSTRAND CORPORATION,

Defendant.

DEPOSITION OF PETER J. SUTTIE
San Diego, California
Thursday, June 29, 2000
Volume 2

Reported by:
RENEE KELCH
CSR No. 5063
Job No. 14814

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BEN SMALL, Hamilton Sundstrand Corporation

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

HONEYWELL INTERNATIONAL INC., and HONEYWELL INTELLECTUAL PROPERTY, INC.,

Plaintiffs,

vs. No. 99-309 (GMS)

HAMILTON SUNDSTRAND CORPORATION,

Defendant.

Deposition of PETER J. SUTTIE, Volume 2, taken on behalf of Plaintiffs, at 600 West Broadway, Suite 1100, San Diego, California, beginning at 9:18 a.m. and ending at 3:39 p.m. on Thursday, June 29, 2000, before RENEE KELCH, Certified Shorthand Reporter No. 5063.

INDEX

EXHIBITS

Tuesday, I noticed this statement.
Q And what, if any, actions have you taken to have this supposedly erroneous statement corrected?
A None.
Q Have you, or to your knowledge anyone at Sundstrand, contacted any customers who've been given this troubleshooting guide to tell them that there's an erroneous statement about inlet guide vane position and setpoint contained in the guide you've given them?
A No.
Q If you look at page HSA 240113, sir. At the bottom of that page, or near the bottom of that page --
A 240143?
Q 113. Do you see in the middle column near the bottom of the page it says IGVACTR, and then P21?
A I see it -- which particular? Yes.
Q Actually, those two abbreviations followed by P21 occurs a couple different places on this page; correct?
A Yes.
Q First of all, IGVACTR, is that an abbreviation or shorthand for inlet guide vane actuator?
A Yes.
Q And is that a line replaceable unit in the APS 3200 as you defined the term a couple minutes ago?

A Yes.
Q And am I correct that this document, Suttie Exhibit 42, is using the designation P21 to refer to the inlet guide vane actuator?
A Yes.
Q And am I right that the inlet guide vane actuator is the piece of hardware that physically opens or closes the inlet guide vanes?
A Yes.
Q And that's the piece of hardware whose position is measured by the electronic control box in the APS 3200; correct?
A Can you repeat that for me, please?
(Record read.)
THE WITNESS: Yes.
BY MR. PUTNAM:
Q Let me get another document for you.
Mr. Suttie, during the development of the APS 3200 was there a term or a variable that was referred to as the B, B as in boy, factor?
A Yes.
Q What was the B factor?
A It was an equation, an algorithm to define a parameter.
Q And what parameter was the B factor used to

define?
A Well, B factor itself was the parameter.
Q And how was the B factor used? Or how was it contemplated that the B factor would be used in the APS 3200?
A It was used to determine which side of curve, known as the delta P on P curve, the load compressor was running on.
Q Which you say "which side of the curve," what do you mean?
A As I mentioned in the previous deposition, there is a relationship between delta P on P and flow, air compressor flow. There is not a unique solution one needs to know which -- the curve has an apex for accurate control. The ECB needs to know which side of that curve the load compressor is functioning.
Q Is the B factor something that's used in the current APS 3200 today?
A No.
Q Why not?
A It was -- it did not adequately accomplish the function.
Q What function?
A To determine which side of the curve the load compressor was functioning on.

Q What's used in the APS 3200 currently in operation today instead of the B factor?
A A pressure ratio measurement.
Q Is that delta P over P?
A No.
Q What is that pressure ratio measurement?
A It's P -- the load compressor outlet pressure ratio to the load compressor inlet pressure.
Q Isn't that -- haven't you just defined delta P over P?
A No.
Q What's the difference between what you just defined and delta P over P?
A Inlet air goes into the load compressor, ambient air is taken into the load compressor, and that is discharged over the load compressor at a high pressure. That is the pressure ratio across the machine. Delta P is as we have described it.
Now, you could say that the pressure ratio I've just discussed is a delta, yes, I agree. But the delta, as we have discussed it, is a delta between pressure in the diffuser and the pressure in the load compressor outlet duct. So it is -- and the P of the delta P on P as we described it, all static pressures, is the duct pressure.

operation?
A Yes.
Q When was it used?
A In the software versions prior to 3.0.
Q And what time frame is that?
A From entry into service, January, '94, so it's sometime in '95. I don't know exactly.
Q How was B critical used during that period of time?
A It was compared with the computed B factor to determine which side of the delta B on B curve we're operating on.
Q And what did the system do once it was determined which side of the delta P over P curve you were operating on? What did it do with that information?
A It used that determination to cause the bleed valve, control valve commanded position to be effective, or to be ignored.
Q And when you say the bleed control valve commanded position, do you mean the position generated by the delta P over P measurement?
A I mean the control logic, which we have discussed earlier, related to P on P, which produced a signal called BCVCTL, I believe.

Q As I understand it, all APS 3200s that went into service between January, 1994 and sometime in 1995, used the B factor compared to B critical, as you've just described it; is that right?
A Yes.
Q Do APUs that went into service during that period still operate that way, or was their software changed?
A Software was changed.
Q So am I right that APUs that went into service after this period in 1995 -- first of all, that APUs that went into service after the period of 1995 never used the B factor compared to B critical in actual operation?
A Correct.
Q And APUs that had gone into service during that first year and a half or so used the B factor compared to B critical during their initial in-service operation, but then had their software reprogrammed to no longer use those factors?
A Correct.
Q And that reprogramming took place sometime in 1995; is that your testimony?
A Sometime in '95. Or early '96.
Q And if we found out when software version 3.0

for the APS 3200 was installed in the field, would that be the time that the change-over was made?
A Yes. With the caveat that 3.2, as it finally ended up being, was recalled for a period, for another reason; previous version of software was used again for a while until version 4.1 entered service.
Q And when did that recall and relapse to the earlier version take place?
A '95, '96.
Q And what's the relationship between 3.0 and 3.2?
A I don't recall.
Q Okay. Just so we have the testimony sequenced correct. Is it your testimony that until version 3.0 of the software was released, the APU used the B factor to B critical comparison, that there was then a period when APUs did not do that, a period again where APUs did do that while a software bug was being fixed, and then when version 4.1 entered service APUs never -- APUs thereafter did not operate using the B factor and B critical?
A Correct.
Q So if we find out when version 4.1 entered service, after that date and after that software was installed on every given APU in service, there was no

use of the B factor and B critical; correct?
A Correct.
Q Now, during the time the B factor and B critical was in actual use for the APS 3200, am I right that as shown on this chart here on Exhibit Suttie 43, B critical was a function of inlet guide vane position?
A Can you define again what you mean by is a function of?
Q Well, let me ask you an open-ended question. What was the relationship between B critical and inlet guide vane position when B critical was in use for the APS 3200?
A The relationship was as defined in this table.
Q So when B critical was in use for the APS 3200, a given inlet guide vane position produced a given B critical value; is that right?
A Correct.
Q And that B critical value was then compared to the measured B factor; correct?
A Yes.
Q And was proportional and integral control applied to the difference between the B critical factor and the measured B factor?
A No.
Q Was any type of control compared -- applied to

10/24/00 Suttie Dep.

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

HONEYWELL INTERNATIONAL INC., and HONEYWELL INTELLECTUAL PROPERTY, INC.,

Plaintiffs,

vs. No. 99-309 (GMS)

HAMILTON SUNDSTRAND CORPORATION,

Defendant.

DEPOSITION OF PETER JOHN SUTTIE
San Diego, California
Tuesday, October 24, 2000
Volume III

Reported by:
JESSICA E. MASSE
CSR No. 9910
JOB No. 16831

UNITED STATES DISTRICT COURT
FOR THE DISTRICT OF DELAWARE

HONEYWELL INTERNATIONAL INC., and HONEYWELL INTELLECTUAL PROPERTY, INC.,

Plaintiffs,

vs. No. 99-309 (GMS)

HAMILTON SUNDSTRAND CORPORATION,

Defendant.

Deposition of PETER JOHN SUTTIE, Volume III, taken on behalf of Plaintiffs, at 501 West Broadway, Suite 1300, San Diego, California, beginning at 9:18 a.m. and ending at 5:11 p.m. on Tuesday, October 24, 2000, before JESSICA E. MASSE, Certified Shorthand Reporter No. 9910.

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RICHARD H. KOSAKOWSKI

INDEX

EXHIBITS

(Plaintiffs' Exhibit 233 was marked for identification by the court reporter.)

BY MS. REZNIK:

Q Exhibit 233 is a coordination memo; correct?

A Yes.

Q And the coordination memo is authored by T, period, Maedche; correct?

A Correct.

Q And that refers to Terry Maedche?

A Correct.

Q What is the subject of this coordination memo?

A Load compressor data.

Q Can you read the first line of the coordination memo for me, please?

A "SPS is currently conducting final surge system development testing, computer" --

Q First sentence of the coordination memo, please.

A "SPS is currently conducting final surge system development testing, computer simulation correlation, and surge system tolerance analysis."

Q Was Mr. Maedche involved in the final surge system development testing referenced in this memo?

A He was involved, yes.

Q Was Mr. Maedche involved in the computer

simulation correlation of the APS 3200 related to the load compressor data?

A We never had a good computer simulation of this system. So while we may have tried to have correlation between computer analysis and actual test data, it was never successful.

Q So it's your testimony that you never did a computer simulation correlation test on the APS 3200?

A A computer simulation correlation test, no. That wouldn't be a computer simulation. It would be a computer program, which is intended to simulate real hardware. We never had a good computer model. It's very complicated, and we never had a good model. So we did our system development on engine tests, as I've mentioned to you previously. This was an attempt to get data to do a computer simulation correlation. It was this engineer's request to do this, as stated here, but it's not --

Q I'm sorry. Continue.

A But we were never very successful at doing simulation of the system.

Q You said this was an attempt to get data to do a computer simulation correlation based on the engineer's request. This engineer's request meaning Terry Maedche?

A Terry Maedche wrote this coordination memo. As I mentioned previously, he was part of the development team. He was working with others to do this system development. So I can't say for sure whether it was someone else's idea or not.

Q When you said "this engineer's request," you were referring to Terry Maedche; correct?

A I was referring to the writer of this coord memo, which is Terry Maedche, yes.

Q Was Mr. Maedche involved in the surge system tolerance analysis, described in the first sentence of this coordination memo, for the APS 3200?

A Yes.

Q What is the purpose of surge system tolerance analysis?

A When evaluating a system, or any part for that matter, not all components behave exactly the same. We make 100 load compressors. They don't all behave exactly the same. There is a tolerance. To make sure that a system works correctly, you need to allot for that variation between the different pieces of hardware. And so when designing a system with enough allowance for the tolerances -- and so that was what was being done here.

The control system has many components. It's

got sensors. It's got the load compressor itself. You need to add up all those tolerances to make sure that the system will always work as required by the customer -- all days, all temperatures, all locations, all altitudes as specified.

Q So it was part of Mr. Maedche's job to request these various surge and tolerance analysis tests for the APS 3200?

THE WITNESS: Can you repeat that, please?

(Record read.)

THE WITNESS: There are multiple things there. This was a request for data from Turbomeca. What you also mentioned was testing, which he was not requesting. It was testing that was being carried out in San Diego. So what he was requesting here was basic performance data for the load compressor.

BY MS. REZNIK:

Q Would Mr. Maedche be involved in analyzing that data?

A Typically not a systems engineer. This is primarily performance information which you get from a performance engineer. The only reason the systems engineer would be interested in this is if we were building a simulation -- a computer program that I mentioned previously.

control system. You only do what's minimally necessary to make the system function properly. To add extra features could have a detrimental effect. So it was not necessary. We did not include IGVs.

Q Did you ever test any version of any APU that included the surge control system depicted in Exhibit 22 or Exhibit 74?

A No.

Q So the information you obtained from Turbomeca relating to the delta P/P setpoint wasn't derived from testing of an APU; is that correct?

A The information we got from Turbomeca -- and you've shown it already in one of the exhibits -- was a relationship between delta P on P and flow. It was derived from rig testing of Turbomeca's hardware and equipment in France. They then gave us the relationship which we used in our control system. It was independent of IGVs as it's stated on the figure you've shown me earlier.

Q Do you know what type of testing was done by Turbomeca?

A You need to ask Turbomeca.

Q So Turbomeca never shared with you the basis of their testing of hardware in deriving the delta P/P flow relationship?

A I never saw the rate they used.

Q You never saw it, but did they ever provide you with any information about the rig testing that they conducted?

A They gave us the data that they collected. That's all the information I care about. I can think of what the rig might have looked like, but I never saw it. I don't really -- it's not really an issue to us. We wanted the output data, which we used.

Q Can you tell me when Turbomeca provided you the information stating that the IGV angles didn't need to affect the setpoint?

A It's written in one of the coord memos. October 25th, 1991.

Q And Turbomeca provided this information in the form of a coordination memo?

A Yes. From Gerard Hardy.

Q Mr. Hardy was your counterpart in Turbomeca; is that correct?

A No. Not at that time.

Q What was his role?

A He was the program manager at that time. His counterpart -- I was the control systems project engineer. So in hierarchy structure, I would have been seen as junior to Mr. Hardy.

Q And Mr. Hardy from Turbomeca was the program manager of this APS 3000 at the time of the 3000 development?

A At Turbomeca. Only responsible for the Turbomeca portion.

Q Let me know if I've got this correct. Is it fair to say that you are not prepared to tell me where Turbomeca has derived the information regarding the unnecessary relationship between the IGVs angle and the setpoint?

MR. McCRACKEN: Objection; ambiguous and vague.

THE WITNESS: Can you repeat the question, please?

MS. REZNIK: Why don't I restate it for you.

Q Are you able to identify for me how Turbomeca derived the information they provided to you on this October 25th, 1991 coordination memo between the relationship of IGV angle and the setpoint?

A They derived that information from rig tests of a compressor. They measured the air flow, measured delta P on P, and through laborious tasks created the relationship by measuring many points and just plotting them along the chart.

Q So is it your testimony that after October 25th, 1991 Sundstrand no longer used variations in

position of the IGV to determine the delta P/P setpoint?

A We never used variations of IGV to establish the delta P on P setpoint. After October 25th, the control -- architecture of the control philosophy changed to incorporate the data from Turbomeca and to delete any reference to IGVs affecting the delta P on P setpoint.

Q So, then, it's fair to say that after October 25th, 1991 Sundstrand no longer contemplated using variations in position of IGVs to affect the delta P/P setpoint?

A That would be a fair statement, yes.

Q Is it fair to say the sole basis for Sundstrand's abandonment of that idea was Turbomeca's data supplied to you in this October 25th, 1991 coordination memo?

A Yes.

Q So Sundstrand didn't do any independent testing or analysis to determine whether or not the relationship between the IGV angle and delta P/P setpoint would work?

A No, we did not.

Q And aside from the rig testing and lead compressor testing by Turbomeca that you think went on, you can't tell me if there was any other basis Turbomeca had for providing you with this information in the

12/6/05 Clark Dep.

IN THE UNITED STATES DISTRICT COURT

DISTRICT OF DELAWARE

HONEYWELL INTERNATIONAL, INC., and HONEYWELL INTELLECTUAL PROPERTIES, INC., Plaintiffs, vs. HAMILTON SUNDSTRAND CORP., Defendant.	No. 99-309-GMS

VIDEOTAPED DEPOSITION OF JIM CROCKER CLARK
Volume 1 (Pages 1- 278)
Phoenix, Arizona
December 6, 2005
9:00 a.m.

PREPARED FOR:
District Court
(Original)

PREPARED BY:
Robin L. B. Osterode, RPR, CSR
AZ Certified Reporter No. 50695

58
called the throat.
Q. And the converging/diverging nozzle has a back end that has a wider opening, correct?
A. The back end expands in area.
Q. And that's called the discharge; am I right?
A. The end of it you can call it the discharge.
Q. In a converging/diverging nozzle, you have a lower pressure at the throat, generally, and a higher pressure at the discharge, correct?
A. The lowest pressure will be in the throat.
Q. And the purpose --
A. Oh --
Q. Go ahead.
A. You can lower -- you could lower the downstream pressures so much that it would choke and the lowest pressure would be at the exit.
Q. I want to talk about choke in a minute, but let's put aside choke conditions, okay?
A. Could you repeat your question, so we can get back on?
Q. Sure. The lowest pressure in a converging/diverging nozzle is generally at the

59
throat of the nozzle, correct?
A. It depends on how much you back-pressure the nozzle. It can be -- the discharge can be greater or it can be less than the throat.
Q. When you have subsonic flow through a converging/diverging nozzle, you'll have lower pressure at the throat than at the discharge, correct?
A. When you have subsonic flow.
Q. And when you have supersonic flow in a converging/diverging nozzle, you can have lower pressure actually at the back end of that nozzle, correct?
A. When you have supersonic flow, you can get a shockwave in there and you'll have lower pressure than at the throat.
Q. And those same principles apply to a diffuser, correct?
MS. STEVENSON: Object to the form.
THE WITNESS: Those same principles in the areas expanding, that's true.
BY MR. LIND:
Q. And those are principles that you have understood and learned about going, again, back to your college days, correct?

60
A. Those are in my textbook.
Q. In your 1950s Shapiro textbook?
A. Right.
Q. Do -- does the position of the inlet guide vanes affect the flow-related parameter in a surge control system?
MS. STEVENSON: Objection; vague and incomplete hypothetical.
THE WITNESS: Can you -- I've already stated you can change the inlet guide vanes and change flow.
BY MR. LIND:
Q. And if you change the inlet guide vanes and change flow, you're going to change the value of the flow-related parameter, correct?
MS. STEVENSON: Objection; vague.
THE WITNESS: If you change the inlet guide vanes and change flow, the flow rate parameter is going to change.
BY MR. LIND:
Q. And that's because the pressures that are being measured in the flow-related parameter are going to change because of the change in the inlet guide vane pressure?
A. The pressures are changing because the

61
flow is changing.
Q. And the flow is changing because the inlet guide vane position is changing?
A. If that's all you did.
Q. Were -- did the 165-9 APU have inlet guide vanes?
A. The 165-9 does not have inlet guide vanes.
MR. LIND: And we're going to ask on the record, and we'll follow up, that documents relating to the 165-9 be produced, because they're, based on his testimony, they're going to be relevant as well and have always been relevant to our document request.
MS. STEVENSON: I disagree with that characterization, but we can deal with it off the record.
BY MR. LIND:
Q. Are you familiar with the concept of compressor surge?
A. Yes, I've heard of compressor surge. I've worked on surge systems, so I'm familiar with the concept.
Q. And again, the concept of compressor surge is a concept that goes back to your college

90
BY MR. LIND:
Q. Mr. Clark, in the late 1970s in connection with the F-18 aircraft, Honeywell used inlet guide vane position as an input into its surge control system, correct?
A. No. It's a fully pneumatic system and it did not use inlet guide vane position.
Q. Okay. In -- when was the first time that Honeywell conceived of using inlet guide vane position as an input into its surge control system?
A. I -- I couldn't say for sure, the first time we ever used it was on a 331-200.
Q. And you know that that surge control system was developed or conceived of at least in the late 1970s, correct?
A. I don't know the exact dates on when we -- I can't remember the exact I worked on it but can't remember the exact dates, whether it was late '70s, early '80s, I can't remember.
Q. And when did Honeywell first conceive of incorporating the position of the inlet guide vane into a surge control system in any way?
A. I don't know when we first conceived of that.
MR. LIND: This is another area where I

91
think the witness was not properly prepared under our 30(b)(6) notice, so we'll ask potentially for a witness to come and testify to those issues.
MS. STEVENSON: I obviously disagree, and for one thing, you haven't showed him a single document and this is not a memory test as we all know, so I disagree with your characterization.
BY MR. LIND:
Q. When you're determining a flow-related parameter in a surge control system, where can you measure the pressure -- well, let me strike that question. Let me take a step back.
We talked about two kinds of pressure so far, total pressure; do you recall talking about total pressure?
A. Correct.
Q. And we talked about static pressure, correct?
A. Correct.
Q. And you know of surge control systems that you've talked about that could use a flow parameter based on either static pressure alone or a combination of static and total pressure measurements, correct?
A. I think I said earlier you couldn't just

92
use one pressure, static pressure as a flow-related parameter; that was your question, correct?
Q. You could take the difference between two static pressure measurements at two different places in the compressor, correct?
A. Correct, you need two.
Q. As a flow-related parameter?
A. As a flow-related parameter.
Q. You could also compare measurements of static pressure and total pressure as a flow-related parameter in a surge control system, correct?
A. That's correct.
Q. And that's a concept that you've been familiar with for how long?
A. Since I've been at Honeywell.
Q. And the same with the two static pressure tap systems, correct?
A. Right.
Q. Now, in designing a surge control system, where can you take the static pressure measurements in order to create your flow-related parameter?
MS. STEVENSON: Objection; vague.
THE WITNESS: The static -- the limiting factor is the static pressure measurements -- there will be a branch that goes to the -- a pipe that goes

93
to the customer, and a pipe that goes to the surge valve, okay, you have to be between the compressor and a branch in those two pipes. In other words, the static pressure has -- the total flow has -- it has to be in a region where the total flow coming out of the compressor is -- because that's what you're trying to control --
BY MR. LIND:
Q. Can you take static pressure measurements in a surge control system in the pipe what you call going to the surge bleed valve?
A. That -- no.
Q. Can you take static pressure measurements to determine your flow-related parameter in the, what you called the pipe going to the customer, the airplane?
A. No, no. It's got to be someplace where the total flow flows through that cross-sectional area where the static port is. "Total flow" meaning all the flow that the compressor is putting out.
Q. Is what you called the pipe going to the --
A. We're talking about load compressors now, is that right?
Q. Correct.

134
good person to call?
A. I don't think he would know either; he couldn't tell you specifically either, I don't think.
Q. How did -- describe for me the logic in the 331-350 where IGV position was used to determine whether the double solution issue existed?
A. Can you repeat the question?
Q. Describe for me the logic in the 331-350 that used inlet guide vane position to determine whether the double solution issue existed?
A. Yeah, I think I already replied to that. There's a -- I believe there's a schedule in there, it's got inlet guide vane position and pressure inputs, and it makes a decision on which side of the curve you're on.
Q. Does it compare inlet guide vane position to a pressure ratio?
A. Does it compare inlet guide vane position to a pressure ratio?
Q. In this schedule.
A. The inputs to the schedule, I think, are, if I recall my memory, is in inlet guide vane position and then there's some pressure, some --
Q. Why does the double solution problem occur in the 331-350?

135
A. Because the static ports were put down in the diffuser.
Q. So any time you put static pressure ports in the diffuser, you can exhibit -- and you get supersonic flow in the diffuser, you'll experience this double solution problem?
A. Yes, that's right.
Q. Where are the static ports in the 331-50-- I'm sorry, where are the static pressure ports within the 331-350 diffuser?
A. I don't know where they are exactly, they're down -- they're in the diffusers and I don't know the location, that was -- if that was the question.
Q. Yes, sir.
And is -- when you're -- the 331-350 uses your Delta P/P flow parameter in its surge control system, correct?
A. That's correct.
Q. So my understanding of the Delta P/P flow-related parameter is that it is total pressure minus static pressure over total pressure, correct?
A. It's total pressure minus static pressure, that quantity over total pressure.
Q. In order to get the double solution

136
problem, don't you need two static pressure measurements, two static pressure ports?
A. No, you can have a total in static.
Q. So in the -- in any APU that uses the Delta P/P flow-related parameter, if the static pressure measurement in that parameter is taken in the diffuser and if you get supersonic flow in the diffuser, you'll experience the double solution problem?
MS. STEVENSON: Objection; asked and answered several times.
THE WITNESS: Any time you get supersonic flow in the diffuser, you get a distortion to that curve.
BY MR. LIND:
Q. The double solution curve?
A. It makes the double solution curve.
Q. Do all of the Honeywell APUs you listed earlier that use the Delta P/P flow-related parameter take the static pressure measurement in the diffuser?
MS. STEVENSON: Object to the form.
THE WITNESS: The 331s -- the 331s all do, I believe.
BY MR. LIND:
Q. The 331-200, therefore --

137
A. I'm sorry, the 331-200 and 250 do not have static taps in the diffuser; it's out in the duct.
Q. Is the difference between the control -- surge control logic to the 331-200 and the 331-350 be the location of the static pressure taps, then?
A. That's correct.
Q. Why did you move the static pressure tap from the duct in the 331-200 to the diffuser in the 331-350?
A. I don't know all the reasons, but I know one reason was to get a larger Delta P signal, which we previously discussed.
Q. Because there's an advantage to having the static pressure measurement in the diffuser, as opposed to out in the duct?
A. There's advantages and disadvantages and that's one of the advantages.
Q. And Honeywell recognized that advantage in changing the surge control logic between the 331-200 and the 331-350, correct?
A. That was a recognized advantage.
Q. And when did Honeywell recognize the advantage of measuring surge -- measuring static pressure in the diffuser, as opposed to the duct?

138

A. On the 350?
Q. On any APU surge control.
A. I -- I couldn't tell you.
MR. LIND: All right. It's 12:25 by my count; let's take a break for lunch and then come back and -- we can go off the record.
THE VIDEOGRAPHER: Okay. We're going off the record at 12:27 p.m.
(Recessed from 12:27 p.m. until 1:32 p.m.)
THE VIDEOGRAPHER: We are back on the record at 1:32 p.m.
BY MR. LIND:
Q. Mr. Clark, does the 165-9 APU experience the double solution problem?
A. The 165-9 doesn't have a load compressor.
Q. You mention that -- so the answer is no?
A. The answer is no.
Q. You mentioned that the 165-9 originally sensed a -- strike that.
There was a surge control system in the 165-9, correct?
A. Correct.
Q. Where was surge occurring or a problem?
A. Where was surge occurring a problem?

139

Q. Well, I assume if you have a surge control system, you have the potential for surge and that's why you have the surge control system; is that right?
A. That's correct.
Q. Where was the surge problem in the 165-9 APU?
A. Where was the -- it doesn't have a load compressor, so it's in the power section compressor.
Q. Okay. So there was the potential in the 165-9 APU to have surge in the compressor?
A. In the compressor.
Q. Can you have the double solution problem in a compressor that is not a load compressor?
A. We don't have any diffuser statics in any compressor that's not a load compressor.
Q. That's a different answer to a different question. Here's my question, can you have the double solution problem in a compressor that is not a load compressor?
A. By design, I don't think you would.
Q. If that compressor had a diffuser, you could have a double solution problem in a compressor that is not a load compressor, correct?
MS. STEVENSON: Objection; argumentative

140

and asked and answered.
THE WITNESS: If you don't have a load compressor, it's usually a bleed machine. And bleed machines take off a little bit of bleed flow, but most of the -- it's an engine, and most of its flow is going through its own turbine, okay, so if you put the statics down in the diffuser to sense flow, you'd see a very small change in flow, because most of the flow is going through the turbine; that's why I said by design you wouldn't have a double solution problem, because you wouldn't put diffuser statics in a machine that didn't have a load compressor.
BY MR. LIND:
Q. In the 165-9 APU, why did you change the flow parameter from just sensing Delta P to sensing Delta P/P?
A. I may have -- the 165-9, I may have stated it incorrectly, I think I tried to correct myself, it's only a Delta P control.
Q. It never changed to a Delta P/P?
A. No, not to my knowledge, that's true.
Q. I want to ask you some more questions about Honeywell's use of inlet guide vane position to solve the double solution problem, okay?
A. (No audible response.)

141

Q. Why did Honeywell use inlet guide vane position to solve the double solution problem?
MS. STEVENSON: Objection; vague.
THE WITNESS: I think -- I didn't work on that, but I -- they looked for some logic to try and find out when that occurs, and one of the parameters that is an influence there is IGV position.
BY MR. LIND:
Q. One of the reasons that you used IGV position to solve the double solution problem is that IGV position influences where you are on the compressor map, right?
A. It changes the compressor map.
Q. So yes?
A. Yes, it changes the compressor map.
Q. Who worked on Honeywell's development of the surge control system that used IGV position to solve the double solution problem?
MS. STEVENSON: Objection; vague.
THE WITNESS: The first -- the first product that we had that had that was the 331-350, and I think I've already given that answer.
BY MR. LIND:
Q. My question is, to the extent you've given some insight on that before, my question is who

154

have the same inverted V or double solution problem as the APS-3200 APU, correct?
MS. STEVENSON: Object to the form. Misstates the document, and I request that you show him his declaration if you're going to purport to quote from it.
BY MR. LIND:
Q. Isn't that right, sir?
THE WITNESS: Is it all right for me to answer the question?
MS. STEVENSON: If you understand the question and can answer it, you can answer it.
THE WITNESS: Okay. These are APUs -- did I say that in my response to Sunstrand's -- okay, can you repeat the question?
BY MR. LIND:
Q. You had written earlier in a declaration in this case that several Honeywell APUs have the same inverted V or double solution problem as the Sundstrand APS-3200, correct, you wrote that?
MS. STEVENSON: Same objections.
THE WITNESS: I can't remember writing that, but the statement is true.
BY MR. LIND:
Q. Okay. And then we asked Honeywell in

155

this document to tell us what those were, and you see that they answered, right, in response?
A. All right.
Q. And if you turn the page onto page 9, there's a list of Honeywell APUs, correct?
A. Correct.
Q. And, sir, do each of those Honeywell APUs exhibit the same double solution problem as the APS-3200?
MS. STEVENSON: Object to the form.
THE WITNESS: I -- the 350 does; I can't speak for the 400, the 500. The 600 has diffuser statics, and as I recall, we don't have any switching logic in the 600. Now these 131 -- I know the 131-9B has logic in there; I assume by "double V solution problem" it's going to be in any of these compressors, but is it a problem? Is that correct, you asked is it a problem?
BY MR. LIND:
Q. Well, let's break that down. For each of the compressors listed at page 9 of Exhibit 4, do they have the potential, because of where the pressure measurements are taken, to exhibit the double solution curve?
A. They have the potential.

156

Q. Now, in which of the compressors listed at page 9 of Exhibit 4 is there -- do they experience the double solution problem?
A. Actually have a problem?
Q. Yes.
A. I know the 350 does, and I believe this 131-9B.
Q. B, as in boy?
A. B, as in boy.
Q. Any others?
A. And I -- I can't tell you on any of the others for sure.
Q. Now, what's the difference between the 331-350 and the 331-9B, as opposed to all the others, that make you certain that --
A. You mean the 131 --
Q. I'm sorry, let me start over, you're right. What's different between the 331-350 and the 131-9B, as compared to the other APUs listed on page 9, that makes those two APUs experience the double solution problem?
A. I can't -- I don't know for sure, but if you're not pulling a bunch of flow, you don't get into that, and that can be on aircraft that can be just how it matches out on the aircraft, that is a

157

speculation, I do not know.
Q. The -- which of the APUs on page 9 of Exhibit 4 use logic that uses the inlet guide vane position to solve the double solution problem, so-called switching logic, as you called it?
A. The 331-350 and I believe the 131-9B.
Q. Would the 331-200 also have the potential for the double solution problem, if it didn't experience it?
A. It does not have diffuser statics, you said 331-200, correct?
Q. Correct.
A. It would not have it because it does not have diffuser statics.
Q. When you say it does not have diffuser statics, do you mean it does not have pressure taps in the diffuser?
A. That's correct.
Q. But all of the APUs listed on page 9 of Exhibit 4 have pressure taps in the diffuser?
A. That's correct.
Q. And in any of the APUs listed on page 9 of Exhibit 4, that solve the double solution problem using inlet guide vane position like the 331-350 -- let me rephrase that, that didn't make any sense.

202
A. We were in competition with Lycoming, I thought was our competitor.
Q. With who?
A. Lycoming.
Q. Lycoming?
A. Lycoming.
Q. Are you sure about that or that's just your best recollection right now?
A. That's my best recollection.
Q. Do you recall one of the Hamilton Sundstrand or predecessor companies offering an APU for the 757 in the late 1970s?
A. I don't recall that.
Q. You mentioned the L-1011; what do you know about the APU for the L-1011?
A. I don't know anything about it.
Q. Do you know who makes it?
A. That was Ham Standard, I believe.
Q. You talked about the APU called the 131-3 earlier today, right?
A. Right.
Q. And that's the one that uses your Delta P/Delta P surge control system, correct?
A. That's correct.
Q. And does the 131-3 experience the

203
potential for the double solution characteristic?
A. It does not have that characteristic.
Q. And why not?
A. It does not have a multi-valued curve. All I know is it, from data we don't have it, and we did not see it. I cannot tell you the physical reason, because I don't know.
Q. Are any of the pressure measurements in the surge control system for the 131-3 static pressure?
A. Yes, there's three pressure taps; two of them are static pressures in the diffuser.
Q. So in the 131-3 you have static pressure taps in the diffuser, correct?
A. That's correct.
Q. And you have two static pressure taps in the diffuser, correct?
A. On each -- on both sides of the vane.
Q. But there are two, correct?
A. To be specific, there's -- I don't know how many vanes in there, and I believe each one has two of these, so I don't want to say there's only two, but they all collected in a manifold, I'm just trying to be precise here, but there's two, you could say that there's two main -- two important ones or

204
there's two on each side of a vane.
Q. In the 131-3 there are at least two static pressure taps in the diffuser?
A. That's correct.
Q. And then there's a third pressure sensor, correct?
A. There's a third pressure.
Q. What pressure does that measure or sense, static or total?
A. I can't remember exactly whether that's a static or a total, but it's in an area of low velocity, so it's a -- so if it's a -- it's closer to a total, it's not down in the diffuser. I believe it's out on the scroll someplace.
Q. You believe that the third pressure tap in the 131-3 is past the diffuser out in the scroll?
A. It's out in the scroll, I believe.
Q. When you measure static pressure at the far end of the diffuser, is that essentially the same as measuring total pressure?
A. It's much closer to total pressure.
Q. And the closer you go to the very end of the diffuser discharge --
A. The closer it gets to total pressure.
Q. I'll accept that, even though we weren't

205
supposed to talk over each other, I think that one worked out okay.
Although you haven't experienced the double solution problem in the 131-3, do you agree that because you're taking static pressure measurements in the diffuser, that the potential for the double solution problem exists?
MS. STEVENSON: Objection; calls for speculation.
THE WITNESS: Are you calling in that application, in the way that we did it, is that what you're saying? In other words, if I have two pressure holes down there, that the potential exists for the double V solution.
BY MR. LIND:
Q. Yeah, in the 131-3, because you have two static pressure sensors in the diffuser, doesn't the potential for the double solution problem exist?
A. I don't believe so. As I explained later, the signal does not turn around and go back, it's not double valued as in the double V solution.
Q. And you don't know why that is, though?
A. All I know is it doesn't do that, and I do not know the physical reason.
Q. At least you haven't experienced the peak